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CHINA'S FIRST VARIABLE STABILITY AIRCRAFT-THE BW-1-GETS ITS PRE-ACCEPTANCE FLIGHT TESTS

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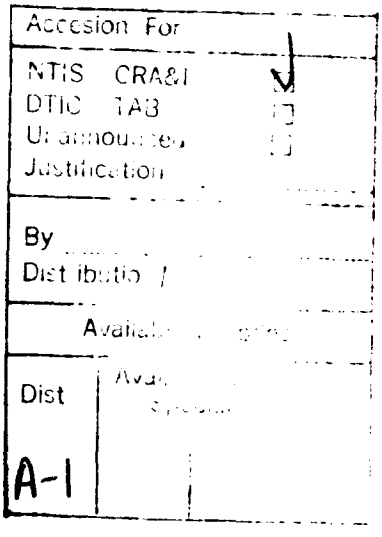

TITLE: CHINA'S FIRST VARIABLE STABILITY AIRCRAFT---
THE BW-1-GETS ITS PRE-ACCEPTANCE FLIGHT TESTS

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The BW-1 variable stability aircraft, which our country designed on its own and refitted, is a research test plane for simulating aerial flight. The refit was completed in March of 1988. In November of the same year, it went through its initial flight technology review. Late in September of 1989, pre-acceptance flight tests on the aircraft were completed. Once this was done, our nation's aviation industry added yet another important type of means for scientific research.

A GENERAL DESCRIPTION OF THE BW-1 VARIABLE STABILITY AIRCRAFT

The BW-1 is an aircraft with variable stability in a vertical or longitudinal direction. It is refitted from the F-6 trainer aircraft. The aircraft's forward cabin has been made over to be the cabin for the test flight review person. It opts for the use of an electrical control system. The rear cabin is the safety pilot's cabin. It preserves the original mechanical type control system. The small pull rod between the two pilots' sticks goes through an electro-magnetic clutch, assisting the disengagement and engagement of the electrical controls and the mechanical controls of the forward and aft cabin pilots' sticks. When the electrical controls are in effect, the aft pilot's stick and the mechanical control system are connected and act together. Once the electrical controls experience a problem, through the emergency disconnect switch, the rear pilot's stick is capable of immediately connecting up in order to take over control of the aircraft in its place.

All together there are 4 types of sequences of events through which it is possible to make the aircraft change over from electrical control to mechanical control: (1) the altered stability control system automatically checks for and detects a malfunction and changes over, (2) the forward/aft pilots manually disconnect the stability alteration system and change over, (3) the stability alteration system is overloaded past its limits in a normal direction and switchs over, or (4) onboard data collection system parameters force the change over. These processes very greatly increase the reliability of the switch over from electrical controls to mechanical controls in the BW-1 aircraft.

During the refit, the BW-1 variable stability aircraft added digital type aerodynamic stability alteration systems, simulation-type electro-hydraulic servo-human sensing systems, digital-type target tracking and display systems, onboard data collection, recording, and telemetry launch systems, test signal generators, atmospheric turbulence signal generators, and various types of sensors, transformers, electrical and hydraulic auxilliary items, and other similar features, for a total of 136 items. In order to increase the installation space, besides getting rid of and switching for various auxilliary items on the original aircraft, an equipment compartment on the belly of the aircraft and a dorsal fin drum pack were also added.

The aerodynamic stability alteration system was test manufactured by our country and opts for the use of the first set of digital-type electrical control systems. They possess malfunction and safety modes. They have a high gain, full powers, many control modes, large ranges of parameter change, system structures with strong flexibility, and other similar advantages. As a result, the stability and following or tracking problems in flight control systems are obvious. Because of this, besides the conventional stability compensation measures, it also went through a changing of auxilliary thrust device slip valves to overcome the limitations associated with oscillation. Use is made of software set ups with structural wave filter devices to decide whether or not servo elasticity and stability are adequate. It makes use of "reserve" or "preparatory" tracking methods to reduce the transient nature of transformations associated with the switch from mechanical control to electrical control. It opts for the use of "force control" methods to compensate for delays over long periods of

time which can possibly come along with system simulations. In conjunction with this, it is possible to study the "location input commands" and "force input commands" which are currently possessed by electrical transmisssion systems. The two simulation modes of pitch speed tracking and normal direction acceleration tracking are not only capable of being used in order to set up a numerical model of the aircraft being simulated, but is also capable of studying the pitch speed command control in the flight control technology as well as the normal direction acceleration command controls. The pure delay links that are set up in the rod linkage model are not only capable of compensating for the dynamic lag or sluggishness. They are also capable of carrying out studies on equivalent systems. The model of auxilliary force devices in the rod linkage models is also capable of acting as a model of the pilot's commands in the model of the electrical controls. The measures above very greatly expanded the range of applications and agility of the variable stability aircraft.

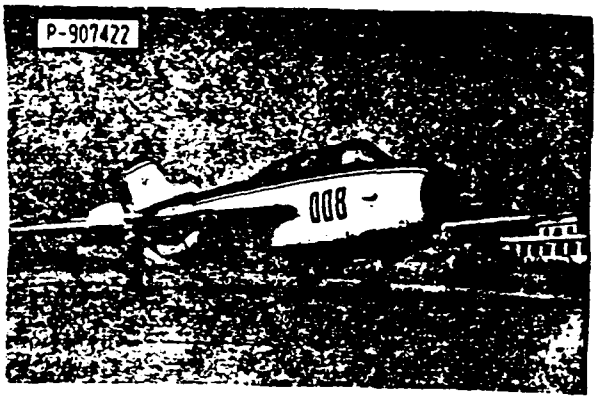
Electro-hydraulic servo human sensor systems were also test manufactured for the first time in China. Going through repeated tests, adjustments and improvements--in particular, with regard to the rationality of the placement positions in the installation on the aircraft of the human sensors or responders in the cabin equipment. This very greatly reduced friction and improved capabilities.

Digital-type target tracking and display systems were also test produced and selected for use for the first time in China. They supply the conditions for closing the link between man and machine and studying aviation product quality.

Data collectors and recorders as well as telemetry launch systems, besides completing data collection and safety controls, also connect up with flight control systems, and are not only capable of supplying to the pilot angles of attack, accelerations in a normal direction, pitch velocities, and other similar indices. Moreover, they are also capable of automatically disconnecting variable stability control systems, and, in conjunction with this, switching over to mechanical control systems.

The ground telemetry control station, after going through corrections, makes use of computers to do calculations on 16 control parameters. Once one among these goes beyond its limit, it immediately and automatically, through the transmitting station, gives the testing pilots a warning. The time from the appearance of the problem to the warning does not exceed 0.2 seconds. This type of system and methodology is the first instance of its being selected for use in our country.

Using the signal put out by standard test signal generators in order to replace manual signals from stick pressures as well as to increase the precision of data processing is also a first instance for this during control test flights in China.



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